

Nine Mathematical Ways of Watching a Baseball Game

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Math with Bad Drawings

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Nine Mathematical Ways of Watching a Baseball Game

Ben Orlin

Math with Bad Drawings

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Synopsis

Whatever its other flaws or merits as a game, baseball gives us plenty of time to think. (How else to spend the 2 hours, 50 minutes when nothing in particular is happening?) In the long gaps between pitches, my own thoughts veer towards mathematics. Are statistics really changing the game? Can any sense emerge from baseball's symmetries and odd patterns? Is it now a sport of science, or as ever one of superstition? And the aesthetic question that arises from all of this: In a human pursuit like baseball, can mathematical perspectives ever help us to create meaning?

1. The Statistician

Alone among the sports, baseball offers an adequate sample size. Each year, a player comes to bat 600 times, faces thousands of pitches, fields hundreds of balls. It takes the NFL over a decade to muster the games that the MLB packs into a single summer. With such ample data, we can witness things a statistician so often promises and so rarely sees firsthand—regression to the mean, fluke coincidences at an appropriate rate, the Law of Large Numbers in action.

The moment itself vanishes. You are your tendencies at the plate—nothing more, nothing less, trailing into the past and projecting into the future. The present at-bat changes nothing, proves nothing. It merely supplies another data point for the great regression analysis that comprises your career.

We dispense with those naive old statistics: RBIs, a pitcher's wins, even batting average and ERA. We still recite them, yes, but only like Greek myths or children's fables—simplistic narratives that once helped the benighted make sense of history. We know better now. We know that “clutch” is a

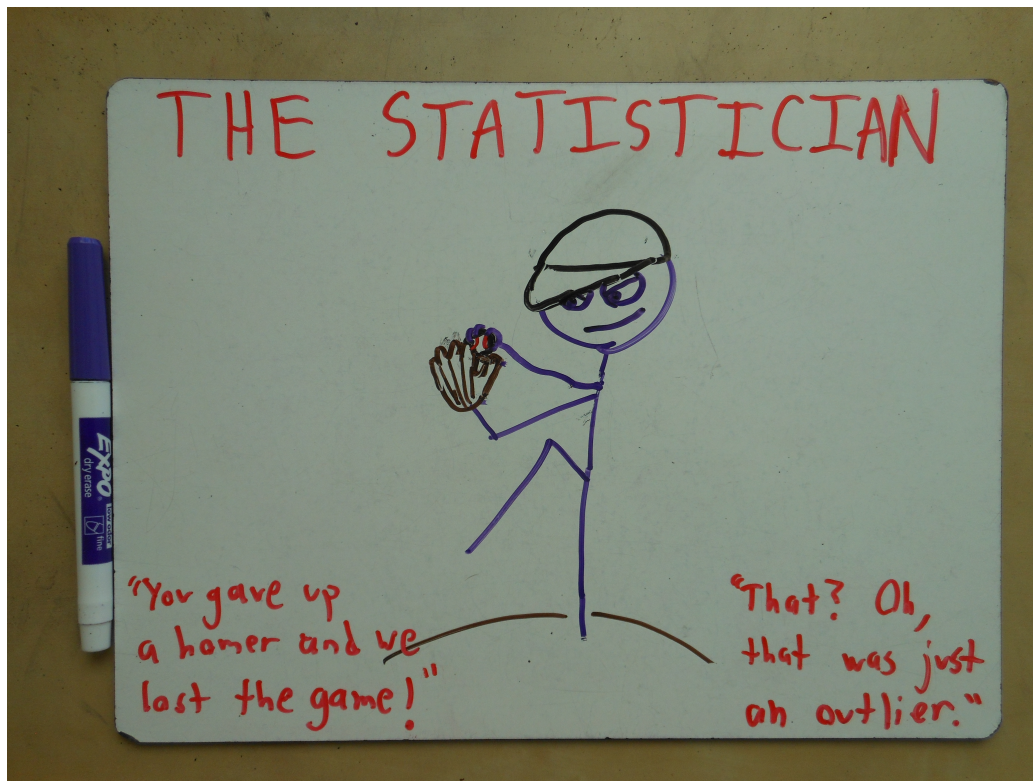


Figure 1: The Statistician.

myth, that defense can be quantified, that stolen bases must succeed at a 70% rate to be worth the risk. We know everything.

All except that great white whale, the playoffs. The sample size is too small; playoff success is just random noise. It bears no relation to the truth of the game, the tendencies that emerge over the long, sweaty summer of the regular season.

The playoffs are just luck, the statisticians tell themselves, while their enemies give interviews and spray champagne.

2. The Combinatorist

If you're new to the game—a late bloomer, a bandwagon-jumper, a spouse watching in reluctant solidarity—baseball seems a very boring sport. It's a scant few minutes of action, spread across three tedious hours of prolonged pauses.

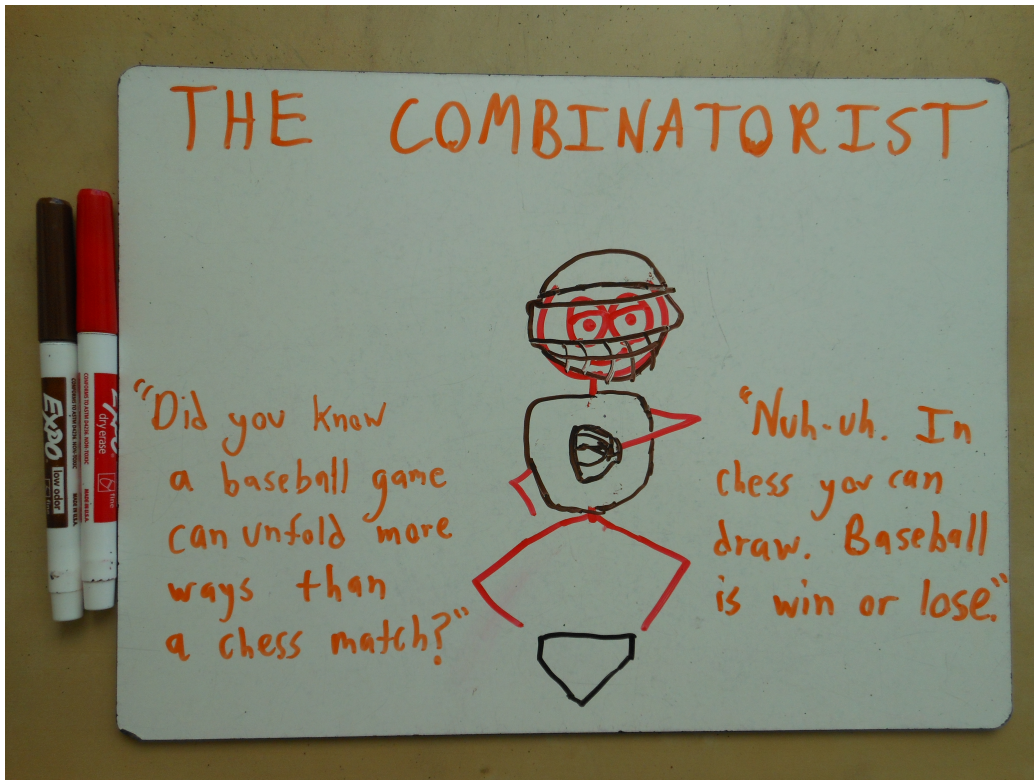


Figure 2: The Combinatorist.

But that's backwards. The pauses are the game. The action—or what appears to be the action—is merely the cathartic transitions from one pause to the next. The pauses are each described completely by a set of variables, like the quantum states of a subatomic particle:

- *Which inning?* 9 possibilities (not counting extras).
- *Top or bottom?* 2 possibilities (and echoes of quarks).
- *How many outs?* 3 possibilities (zero, one, or two).
- *How many strikes?* 3 possibilities (zero, one, or two).
- *How many balls?* 4 possibilities (zero, one, two, or three).
- *Who's on base?* 8 possibilities (empty; loaded; man on first; man on second; man on third; first and second; second and third; the corners).
- *What's the score?* 100 possibilities, if we limit ourselves to 9 runs per side.

All in all: $9 \times 2 \times 3 \times 3 \times 4 \times 8 \times 100 = 518,400$ quantum states for a baseball game, each unique, each a world unto itself.

But even the combinatorist knows that this taxonomy barely scratches the surface. It leaves out the leaky bullpens, the playoff beards, the sliding catches, the ghosts of errors past. Baseball is a theater with 500,000 sets, and that number pales beneath the variety of characters and scripts that might take the stage.

3. The Fractal Geometer

Everyone notes the threes, and the threes within threes. Three strikes to an out. Three outs to an inning. Three-squared innings in the game. Three-squared players in the field. Everything in baseball is a microcosm of something larger— including the game itself, which stands perhaps for democracy, or individualism, or fate.

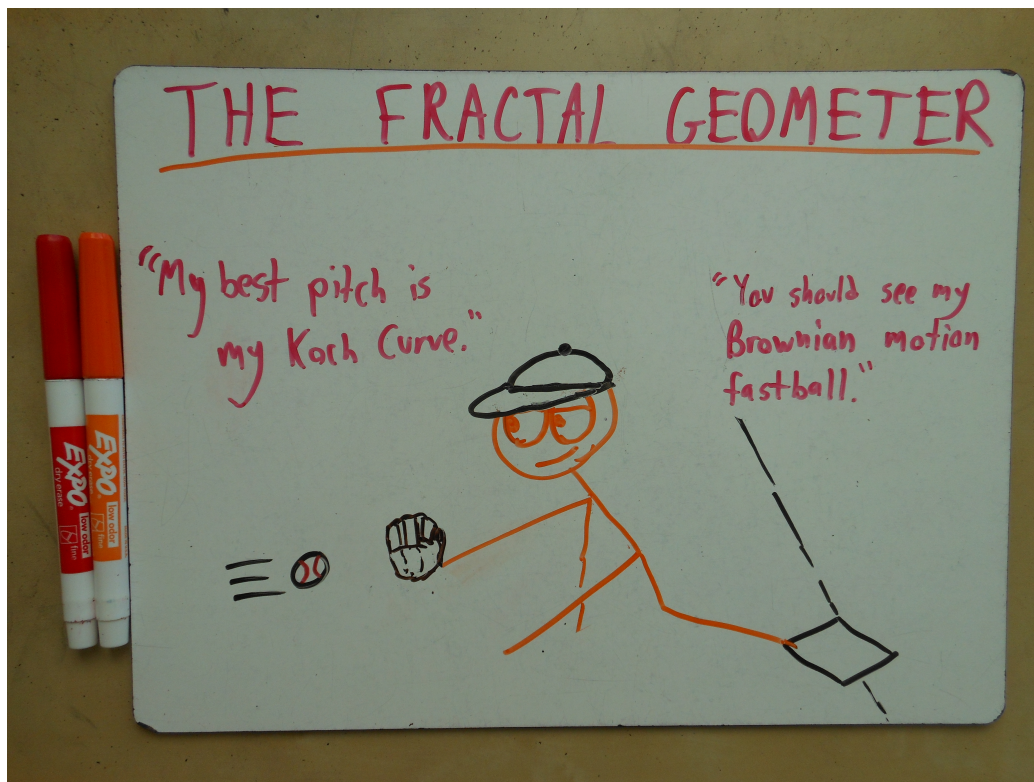


Figure 3: The Fractal Geometer.

4. The Analyst

The inches, the epsilons, the tiny distances—yes, they matter in every game. But in baseball, it's not just rare moments like putts, first-down lunges and shots off the post. It's every pitch.

Who but an analyst would dream up the strike zone? It's a bounded system, demanding pinpoint precision, where small errors can prove fatal. It's an analyst's perfect playground.

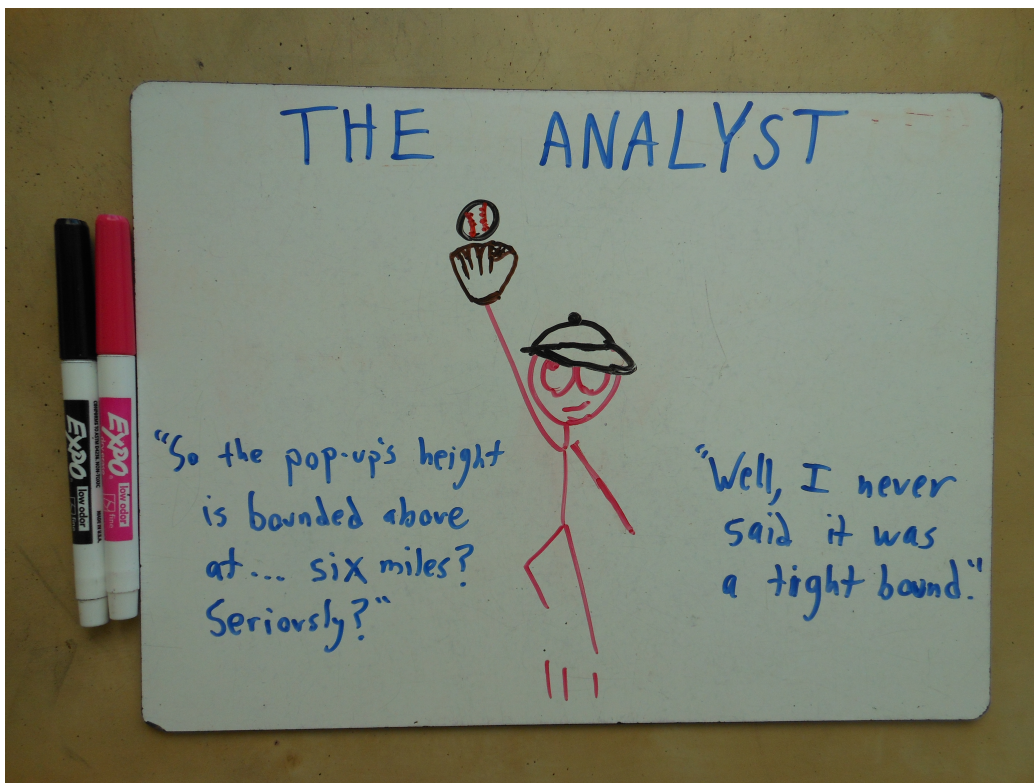


Figure 4: The Analyst.

Baseball has an analyst's fussiness, an analyst's hypersensitivity to small changes. When they're leaving the pitcher's hand, the difference between a great pitch and a terrible one is a few millimeters. When crossing the plate, the difference is half a foot. And a moment later, the great pitch is in the catcher's mitt, while the terrible pitch has landed 400 feet distant in the left-field bleachers. The cause of the disparity might be no more than a slight mis-grip, a brief hesitation, a gust of wind. Mere epsilons spell out fates.

5. The Logician

Baseball is a game of intricacies and mishaps. Its rulebook is thick with exceptions, and exceptions to exceptions.

A foul is a strike. Except if there are two strikes already—then it's nothing. Except if it's a foul bunt with two strikes—then it's a strike again.

Strike three, you're out. Except if the catcher drops it—then you can run to first. Except if first base is occupied—then you're out all over again. Except if there are already two outs—then the race to first is back on.

No other sport offers a rulebook so gerrymandered, so endlessly modified. Certainly not soccer—don't use your hands; kick it in the goal; and all else pretty much follows. Football, like chess, offers a board full of specialized pieces, but there's a brute rationality to the laws governing their motion. Even basketball, that awkward giraffe of a game, presents a more coherent body of law than baseball.

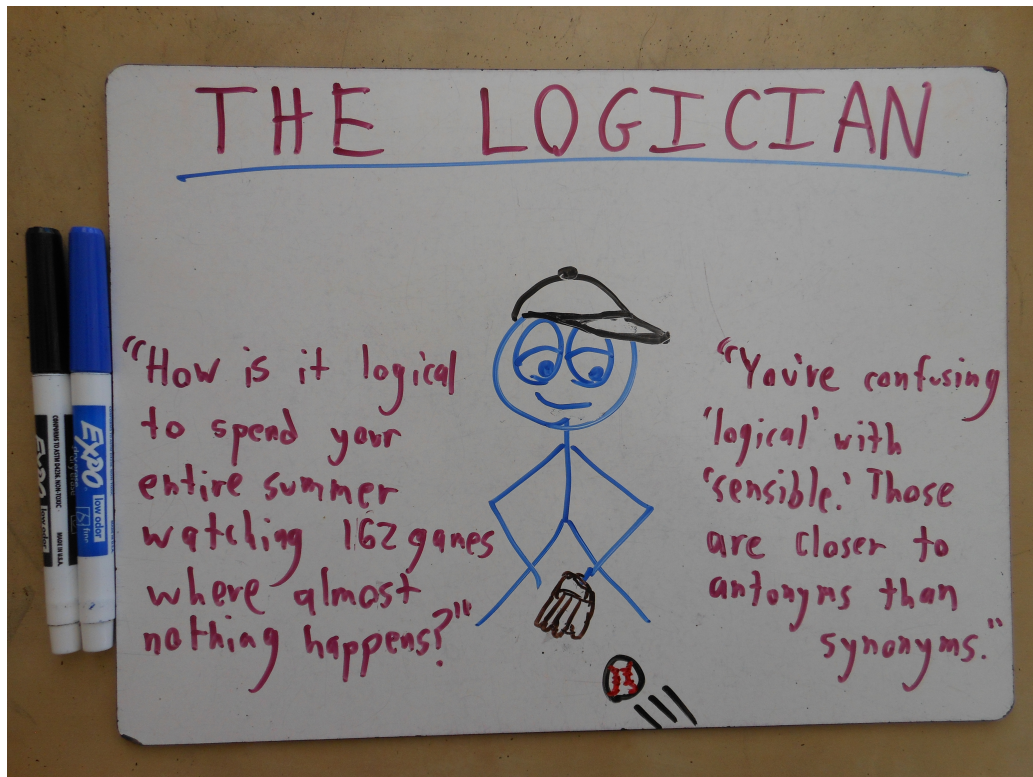


Figure 5: The Logician.

Baseball's rulebook resembles a mathematician's text. It offers obscure distinctions, qualifying statements, and pages upon pages of definitions.

The infield fly rule is a magnificent theorem. It states that an infield pop-up, with runners on first and second and less than two men down, is an automatic out. Like all theorems, it applies only under specific conditions, and is a necessary truth—if it did not exist, infielders could deliberately drop such pop-ups and turn devious double (or triple) plays. You can easily picture undergraduates huddled in the library, fretting as they try to commit these convoluted technicalities to memory.

But baseball's rulebook leaves crucial judgments—balks, obstruction, even balls and strikes—exposed to human error. Baseball has humanity in its core, and therefore, the potential for contradiction, impossible to eradicate. In that, it's just like logic itself. Perhaps Gödel is to blame.

6. The Topologist

Imagine if a football stadium featured a 90-yard field, or a soccer arena moved its nets off-center, or a basketball court angled its backboards at 30 degrees. Those alterations would never fly. Purists would tear the offending stadium down brick by brick.

And yet Fenway Park has the Green Monster.

No two ballparks are alike. The outfield wall may come as close as 302 feet, or stand as far as 436. The Houston centerfield features a hill and a flagpole, both in play. In domes, catwalks running across the ceiling can turn lazy fly balls into ground rule homers. "Pitcher's parks" feature plenty of foul territory, and "hitter's parks" almost none. Even as humanity celebrates its third century of increasing standardization, baseball remains a feudal patchwork, lacking common language or currency.

It's a league only a topologist can love.

A topologist reconciles shapes that appear irreconcilable. A cube is a sphere. A donut is a teacup. The topologist's eye possesses a trained blindness to idiosyncrasy and deformity, seeing only the strange homeomorphisms by which two quite different surfaces might disguise a common character.

And the topologist is right. Who cares about the architecture of the outfield walls? A stadium is a stadium, and baseball is baseball, wherever it's played.

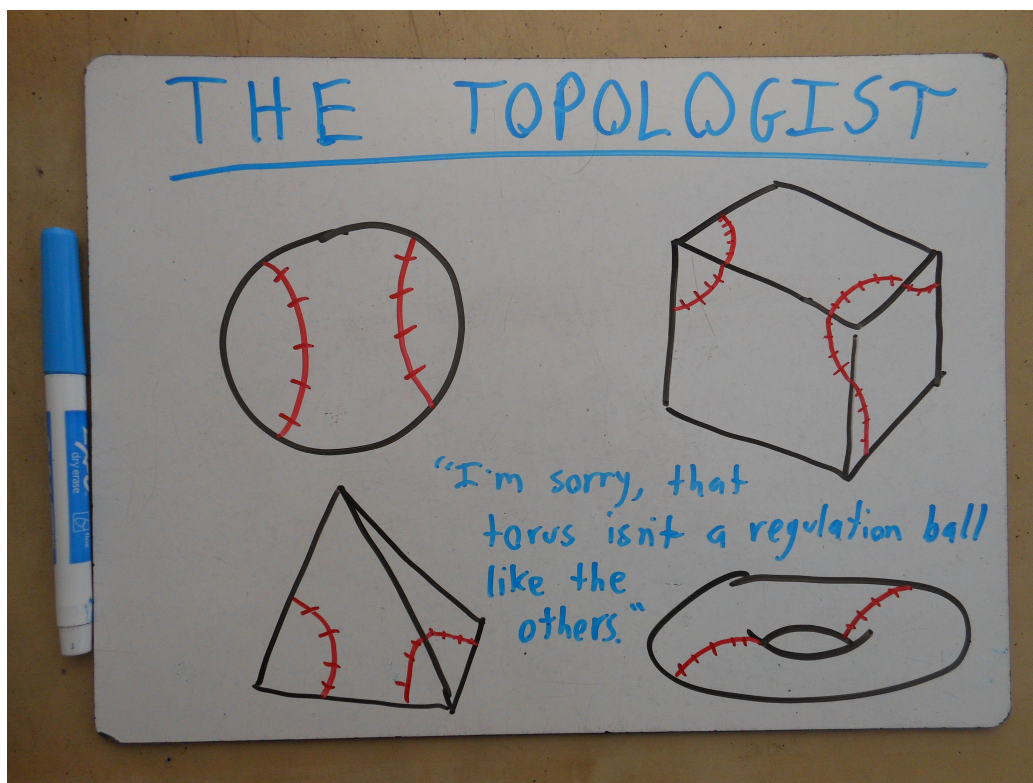


Figure 6: The Topologist.

7. The Game Theorist

The baseball manager probably has less control over the game than any other coach in sports. It's why the 1994 movie *Little Big League*, in which twelve-year-old Billy Heywood inherits the Minnesota Twins and names himself manager, almost makes sense. Aside from sending your pitchers out to pitch and your batters out to bat, what really can you do? Pinch-run here and there, call for the occasional steal or intentional walk? It doesn't seem so tough. As Billy's friend urges in the movie: "C'mon, it's the American League! They've got the DH! How hard can it be?"

While the football coach must reckon with the sprawling continuum of possible play designs, the baseball coach faces a pleasingly finite list of strategic duties:

- Choosing the line-up.
- Bringing in relief pitchers.
- Pinch-hitting, pinch-running, and defensive substitutions.
- Stealing, bunting, and sacrificing.
- Intentional walks and pitch-outs.
- Defensive positioning—infield in, shifts, doubles defense, etc.

These decisions are discrete, plain to the amateur, and wonderfully easy to second-guess. If we can outthink the guy on the bench, we armchair theorists emerge feeling plausibly as though we could be MLB managers.

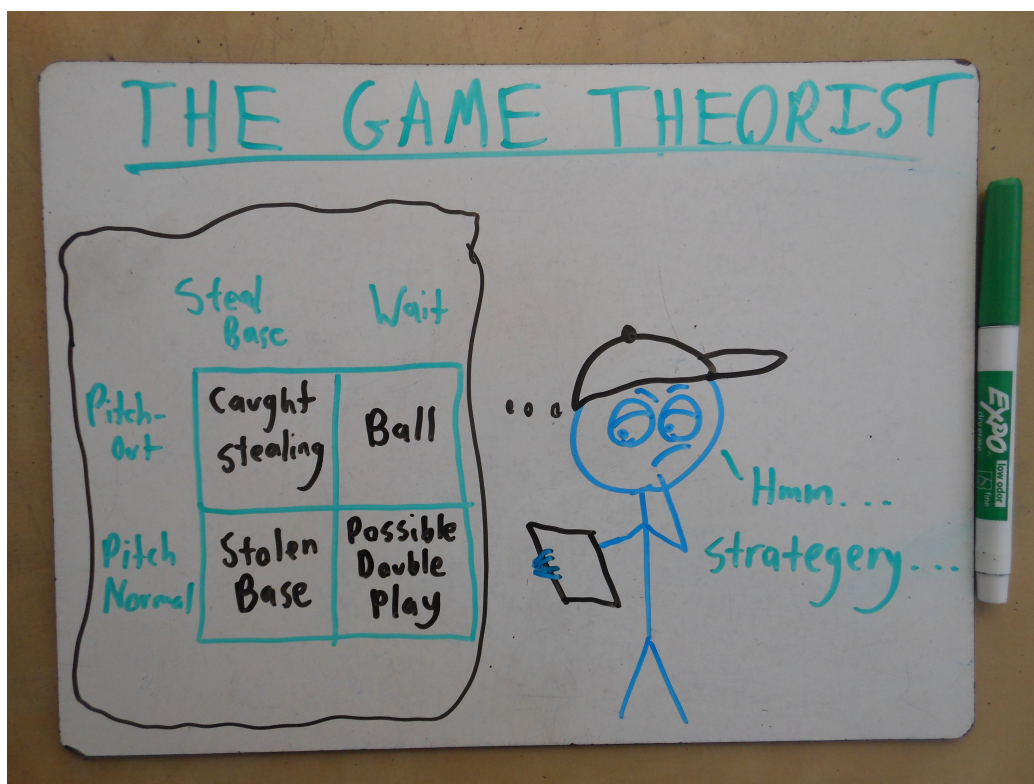


Figure 7: The Game Theorist.

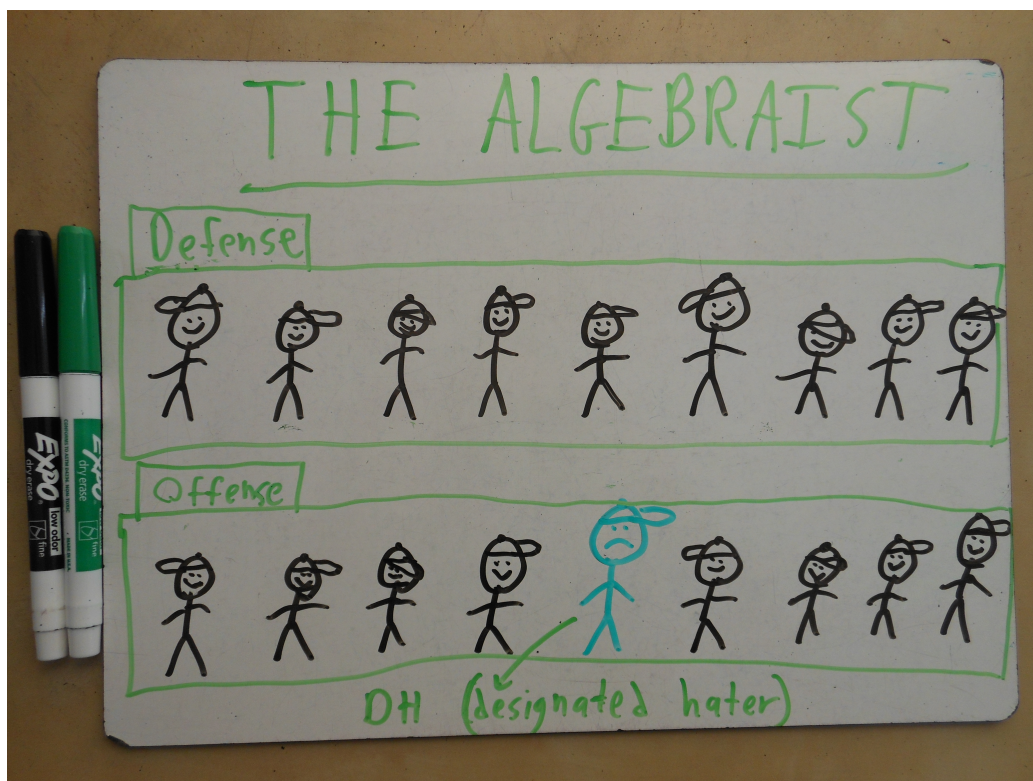


Figure 8: The Algebraist.

8. The Algebraist

In light of all the beautiful symmetries of the game—each fielder must bat; each batter must field; even the playing surface itself is called the “diamond”—it’s hard to swallow the DH rule. It’s a flaw in the diamond, and worse still, it obviates the need for the double switch, that lovely transposition in the sequence of the lineup. I love David Ortiz as much as anybody, but let him play first base.

The DH marks an uncomfortable lurch in the direction of football, with two separate but allied teams (an “offense” and a “defense”) joining forces to do battle, occasionally sharing members but never sharing the field. In baseball, as in group theory, symmetry ought to be king.

9. The Numerologist

As desperately as we try to claim it, baseball doesn't yet belong to the forces of science and enlightenment. It remains a realm of superstition, a game played by and for astrologers.

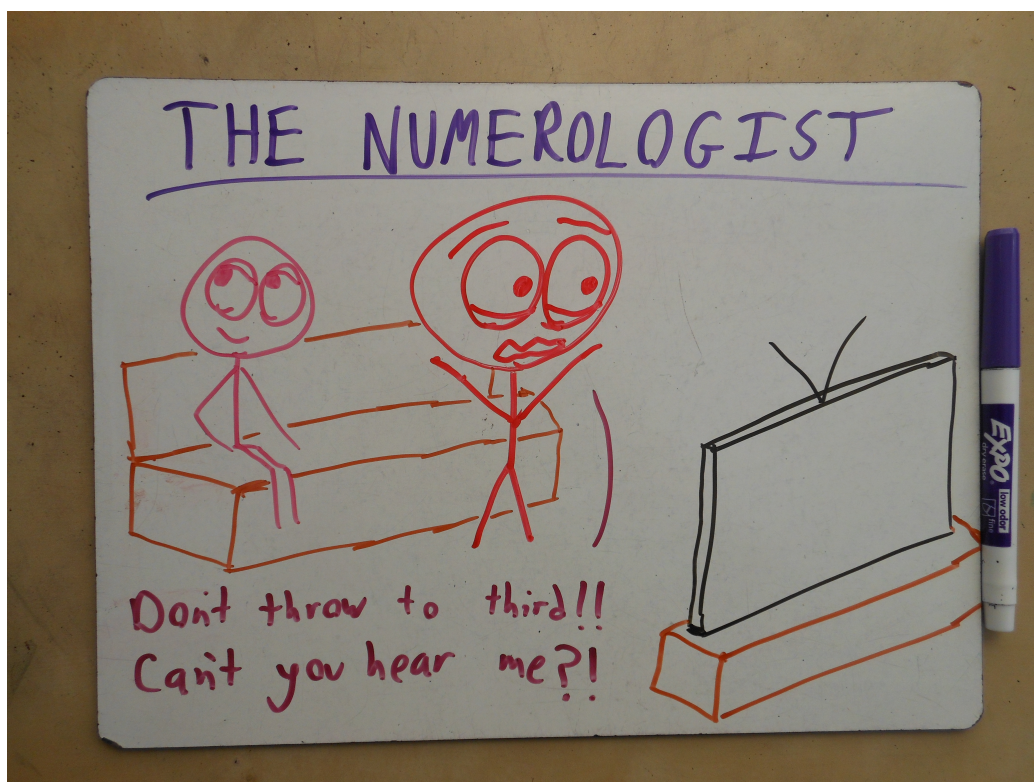


Figure 9: The Numerologist.

Watch the batter perform his glove-adjusting sacraments, or the pitcher hop over the foul line. Check out the kids in the stands, the angels of unjustified hope, wearing gloves even though they're 480 feet from home plate, and less likely to catch a home run than an errant hot dog from the upper deck. In the late innings, you'll see grown men and women praying—actually praying!—for their team to mount a comeback. Listen to the commentators, with their bizarre cherry-picked statistics, and their infuriating faith in debunked old-school theories of the game.

Then examine yourself. Stephen Drew comes up, 4 for his last 40. My left brain dismisses that small sample, says that anything can happen. But my pessimism overrides. “He’s going to strike out,” I say. I know I’m right.

He homers.

Later, I’m leaning forward on the couch, body tense, trying to keep my wife’s laptop screen out of view. It’s an ill omen. How can she work at a time like this, when the Red Sox need her psychic energy? Does she expect them to survive this inning on my psychic energy alone?

I believe the statisticians. I believe the game’s psychological element is epiphenomenal, mere sparks and fizz playing out on the surface of our minds, while the real action unfolds according to the slow calculus of tendencies and probabilities. I believe this without proof, against all instincts and evidence to the contrary. I guess that makes me a numerologist as bad as all the rest of them.